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978-1-107-06043-2 - Handbook of Computational Social Choice

Edited by Felix Brandt, Vincent Conitzer, Ulle Endriss, Jérôme Lang and Ariel D. Procaccia

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## **Handbook of Computational Social Choice**

The rapidly growing field of computational social choice, at the intersection of computer science and economics, deals with the computational aspects of collective decision making. This handbook, written by thirty-six prominent members of the computational social choice community, covers the field comprehensively. Chapters devoted to each of the field's major themes offer detailed introductions. Topics include voting theory (such as the computational complexity of winner determination and manipulation in elections), fair allocation (such as algorithms for dividing divisible and indivisible goods), coalition formation (such as matching and hedonic games), and many more. Graduate students, researchers, and professionals in computer science, economics, mathematics, political science, and philosophy will benefit from this accessible and self-contained book.

Felix Brandt is Professor of Computer Science and Professor of Mathematics at Technische Universität München.

Vincent Conitzer is the Kimberly J. Jenkins University Professor of New Technologies and Professor of Computer Science, Professor of Economics, and Professor of Philosophy at Duke University.

Ulle Endriss is Associate Professor of Logic and Artificial Intelligence at the Institute for Logic, Language and Computation at the University of Amsterdam.

Jérôme Lang is a senior researcher in computer science at CNRS-LAMSADE, Université Paris-Dauphine.

Ariel D. Procaccia is Assistant Professor of Computer Science at Carnegie Mellon University.

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# Handbook of Computational Social Choice

Edited by

**Felix Brandt**

Technische Universität München

**Vincent Conitzer**

Duke University

**Ulle Endriss**

University of Amsterdam

**Jérôme Lang**

CNRS

**Ariel D. Procaccia**

Carnegie Mellon University



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# Foreword

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Hervé Moulin

Axiomatics and algorithmics are two methodologies at the forefront of modern mathematics. The latter goes back to the very birth of mathematics, whereas the former was not developed until Hilbert's famous contributions in the late 1800s.

Yet the axiomatic approach was the first to appear in modern social sciences, through the instant success in 1951 of K. Arrow's *Social Choice and Individual Values*. Beyond the negative, discouraging message of its famous (im)possibility theorem, that book had an immensely positive influence on the development of mathematical economics. It opened the way to the critical evaluation of actual democratic institutions through the filter of "self-evident" normative principles. Conversely, it allowed us to define "optimal" rules for collective decision making and/or the allocation of scarce resources by the convergence of a collection of such principles. In short, it started the field of *mechanism design*.

Cake division is probably the first instance of an economic model with an algorithmic twist. The mathematical statement of the problem goes back to B. Knaster and H. Steinhaus in the 1940s: it combines the normative choice of fairness axioms with the algorithmic concern for a protocol made of simple "cut and choose" operations. This literature did not have noticeable influence on the exponential development of mechanism design in the last 40 years, in part because it was developed mostly by mathematicians. Computational social choice will, I believe, bring it out from its relative obscurity.

In less than two decades, the COMSOC community has generated an intense dialogue between economists working on the normative side of mechanism design and computer scientists poised to test the computational complexity of these mechanisms. A remarkable side product of this collaboration is clear from the choice of the 19 thorough chapters. Under a common axiomatic and computational umbrella, they discuss

- the social choice problem of selecting a public outcome from the conflicting opinions of the citizens
- the microeconomic problem of dividing private commodities fairly and efficiently when individual preferences differ

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- the market design problem of (bilaterally) matching employees to firms, students to schools, and so on
- the design of reputation indices and ranking methods in peer-to-peer systems such as the Internet
- the formation and stability of “local public goods,” that is, (hedonic) coalitions of agents with common interests

The relative weights of these problems are naturally quite unequal, but the point is their coexistence.

The book offers to noneconomists an outstanding self-contained introduction to normative themes in contemporary economics and to economists a thorough discussion of the computational limits of their art. But I also recommend it to anyone with a taste for axiomatics: it is replete with new and open questions that will be with us for some time.

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## Contributors

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**Haris Aziz** NICTA and University of New South Wales, Sydney, Australia

**Craig Boutilier** Department of Computer Science, University of Toronto, Canada

**Sylvain Bouveret** Laboratoire d'Informatique de Grenoble, Université Grenoble-Alpes, France

**Felix Brandt** Institut für Informatik, Technische Universität München, Germany

**Markus Brill** Department of Computer Science, Duke University, United States of America

**Ioannis Caragiannis** Department of Computer Engineering and Informatics, University of Patras, Greece

**Georgios Chalkiadakis** School of Electronic and Computer Engineering, Technical University of Crete, Greece

**Yann Chevaleyre** Laboratoire d'Informatique de Paris Nord, Université Paris-Nord, France

**Vincent Conitzer** Department of Computer Science, Duke University, United States of America

**Edith Elkind** Department of Computer Science, University of Oxford, United Kingdom

**Ulle Endriss** Institute for Logic, Language and Computation (ILLC), University of Amsterdam, The Netherlands

**Piotr Faliszewski** Katedra Informatyki, AGH University of Science and Technology, Poland

**Felix Fischer** Statistical Laboratory, University of Cambridge, United Kingdom

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CONTRIBUTORS

**Paul Harrenstein** Department of Computer Science, University of Oxford, United Kingdom

**Edith Hemaspaandra** Department of Computer Science, Rochester Institute of Technology, United States of America

**Lane A. Hemaspaandra** Department of Computer Science, University of Rochester, United States of America

**Olivier Hudry** Institut Mines-Télécom, Télécom ParisTech and CNRS, France

**Bettina Klaus** Faculty of Business and Economics, University of Lausanne, Switzerland

**Jérôme Lang** Laboratoire d'Analyse et Modélisation de Systèmes pour l'Aide à la Decision (LAMSADE), CNRS and Université Paris-Dauphine, France

**David F. Manlove** School of Computing Science, University of Glasgow, United Kingdom

**Nicolas Maudet** Sorbonne Universités, UPMC Univ. Paris 06, CNRS, LIP6 UMR 7606, France

**Rolf Niedermeier** Fakultät Elektrotechnik und Informatik, Technische Universität Berlin, Germany

**Ariel D. Procaccia** Computer Science Department, Carnegie Mellon University, United States of America

**Jeffrey S. Rosenschein** School of Computer Science and Engineering, The Hebrew University of Jerusalem, Israel

**Francesca Rossi** Department of Mathematics, University of Padova, Italy

**Jörg Rothe** Institut für Informatik, Heinrich-Heine-Universität Düsseldorf, Germany

**Rahul Savani** Department of Computer Science, University of Liverpool, United Kingdom

**Arkadii Slinko** Department of Mathematics, University of Auckland, New Zealand

**Moshe Tennenholtz** Faculty of Industrial Engineering and Management, Technion-Israel Institute of Technology, Israel

**William Thomson** Department of Economics, University of Rochester, United States of America

**Toby Walsh** University of New South Wales and NICTA, Sydney, Australia

**Virginia Vassilevska Williams** Computer Science Department, Stanford University, United States of America

**Michael Wooldridge** Department of Computer Science, University of Oxford, United Kingdom

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**CONTRIBUTORS**

**xv**

**Lirong Xia** Computer Science Department, Rensselaer Polytechnic Institute, United States of America

**Aviv Zohar** School of Computer Science and Engineering, The Hebrew University of Jerusalem, Israel

**William S. Zwicker** Department of Mathematics, Union College, United States of America